

IN THE CLAIMS

Please amend Claims 1, 5, 6, 9-13, 17, 18 and 21-24, to read as follows.

1. (Currently Amended) A ferroelectric thin film element comprising a substrate and an epitaxial ferroelectric thin film ~~that has a plurality of crystal faces and that~~ is provided on said substrate,

wherein said epitaxial ferroelectric thin film satisfies a relation $z/z_0 > 1.003$,
~~wherein a crystal face parallel to a crystal face of a surface of said substrate, among the~~
~~crystal faces of said epitaxial ferroelectric thin film, is taken as a Z crystal face, a face~~
~~spacing of the Z crystal face is taken as z and a face spacing of the Z crystal face of a~~
~~material constituting said epitaxial ferroelectric thin film in a bulk state is taken as z_0~~
where z is the c-axis lattice constant of the epitaxial ferroelectric thin film and z_0 is the c-
axis lattice constant of a material constituting said epitaxial ferroelectric thin film in a bulk
state, and

wherein said epitaxial ferroelectric thin film also satisfies a relation $0.997 \leq$
 $x/x_0 \leq 1.003$, ~~wherein one of the crystal faces of said epitaxial ferroelectric thin film~~
~~perpendicular to the Z crystal face is taken as an X crystal face, a face spacing of the X~~
~~crystal face is taken as x and a face spacing of the X crystal face of the material~~
~~constituting said epitaxial ferroelectric thin film in a bulk state is taken as x_0 where x is the~~
a-axis lattice constant of the epitaxial ferroelectric thin film and x_0 is the a-axis lattice
constant of a material constituting said epitaxial ferroelectric thin film in a bulk state.

2. (Original) A ferroelectric thin film element according to claim 1,

wherein said epitaxial ferroelectric thin film has a thickness within a range of 2 to 100 nm.

3. (Original) A ferroelectric thin film element according to claim 1, further comprising at least a buffer layer between said substrate and said epitaxial ferroelectric thin film.

4. (Original) A ferroelectric thin film element according to claim 3, wherein at least one of said substrate and said buffer layer is electroconductive.

5. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein a crystal orientation degree of ~~the Z~~ a crystal [[face]] plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate, measured by a $2\theta/\theta$ method with an X-ray incident angle θ to the [[Z]] crystal [[face]] plane of said epitaxial ferroelectric thin film parallel to the crystal plane of the surface of said substrate, is 90 % or higher.

6. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein ~~the Z~~ a crystal face plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate has a crystal orientation degree of 99 % or higher.

7. (Original) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film has a perovskite structure.

8. (Original) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film includes a lead (Pb) atom or an oxygen (O) atom as a constituent atom.

9. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film has a tetragonal crystal structure and ~~the~~ a crystal face plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate is a (001) ~~face~~ plane.

10. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film has a rhombohedral crystal structure and ~~the~~ a crystal face plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate is a (111) ~~face~~ plane.

11. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film has a hexagonal crystal structure and ~~the~~ a crystal face plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate is a (0001) ~~face~~ plane.

12. (Currently Amended) A ferroelectric thin film element according to claim 1, wherein said epitaxial ferroelectric thin film has a rhombic crystal structure and

the Z a crystal face plane of said epitaxial ferroelectric thin film parallel to a crystal plane of a surface of said substrate is a (011) face plane.

13. (Currently Amended) A piezoelectric actuator comprising a substrate and an epitaxial ferroelectric film ~~that has a plurality of crystal faces and that is~~ provided on said substrate,

wherein said epitaxial ferroelectric film satisfies a relation $z/z_0 > 1.003$, ~~wherein a crystal face parallel to a crystal face of a surface of said substrate, among the crystal faces of said epitaxial ferroelectric film, is taken as a Z crystal face, a face spacing of the Z crystal face is taken as z and a face spacing of the Z crystal face of a material constituting said epitaxial ferroelectric film in a bulk state is taken as z_0 where z is the c-axis lattice constant of the epitaxial ferroelectric film and z_0 is the c-axis lattice constant of a material constituting said epitaxial ferroelectric film in a bulk state, and~~

wherein said epitaxial ferroelectric film also satisfies a relation $0.997 \leq x/x_0 \leq 1.003$, ~~wherein one of the crystal faces of said epitaxial ferroelectric film perpendicular to the Z crystal face is taken as an X crystal face, a face spacing of the X crystal face is taken as x and a face spacing of the X crystal face of the material constituting said epitaxial ferroelectric film in a bulk state is taken as x_0 where x is the a-axis lattice constant of the epitaxial ferroelectric film and x_0 is the a-axis lattice constant of a material constituting said epitaxial ferroelectric film in a bulk state.~~

14. (Previously Presented) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a thickness within a range of 100 nm to 10 μm .

15. (Original) A piezoelectric actuator according to claim 13, further comprising at least a buffer layer between said substrate and said epitaxial ferroelectric film.

16. (Original) A piezoelectric actuator according to claim 15, wherein at least one of said substrate and said buffer layer is electroconductive.

17. (Currently Amended) A piezoelectric actuator according to claim 13, wherein a crystal orientation degree of ~~the-Z~~ a crystal face plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate, measured by a $2\theta/\theta$ method with an X-ray incident angle θ to the ~~[[Z]]~~ crystal face plane of said epitaxial ferroelectric film parallel to the crystal plane of the surface of said substrate, is 90 % or higher.

18. (Currently Amended) A piezoelectric actuator according to claim 13, wherein ~~the-Z~~ a crystal face plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate has a crystal orientation degree of 99 % or higher.

19. (Original) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a perovskite structure.

20. (Original) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film includes a lead (Pb) atom or an oxygen (O) atom as a constituent atom.

21. (Currently Amended) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a tetragonal crystal structure and ~~the Z a crystal face~~ plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate is a (001) face plane.

22. (Currently Amended) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a rhombohedral crystal structure and ~~the Z a crystal face~~ plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate is a (111) face plane.

23. (Currently Amended) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a hexagonal crystal structure and ~~the Z a crystal face~~ plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate is a (0001) face plane.

24. (Currently Amended) A piezoelectric actuator according to claim 13, wherein said epitaxial ferroelectric film has a rhombic crystal structure and ~~the Z~~ a crystal face plane of said epitaxial ferroelectric film parallel to a crystal plane of a surface of said substrate is a (011) face plane.

25. (Original) A liquid discharge head for discharging a liquid utilizing a piezoelectric actuator according to claim 13.